

Injection Wells

The Hidden Risks of Pumping Waste Underground

Injection Wells: The Poison Beneath Us



A class 2 brine disposal well in western Louisiana near the Texas border. The well sat by the side of the road, without restricted access. (Abrahm Lustgarten/ProPublica)

by [Abrahm Lustgarten](#)
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Over the past several decades, U.S. industries have injected more than 30 trillion gallons of toxic liquid deep into the earth, using broad expanses of the nation's geology as an invisible dumping ground.

No company would be allowed to pour such dangerous chemicals into the rivers or onto the soil. But until recently, scientists and environmental officials have assumed that deep layers of rock beneath the earth would safely entomb the waste for millennia.

There are growing signs they were mistaken.

Records from disparate corners of the United States show that wells drilled to bury this waste deep beneath the ground have repeatedly leaked, sending dangerous chemicals and waste gurgling to the surface or, on occasion, seeping into shallow aquifers that store a significant portion of the nation's drinking

This article is part of an ongoing investigation:

Injection Wells: The Hidden Risks of Pumping Waste Underground
Injection wells used to dispose of the nation's most toxic waste are showing increasing signs of stress as regulatory oversight falls short and scientific assumptions prove flawed.



Types of Injection Wells

Class 1	Class 2	Class 3	Class 4	Class 5	NEXT
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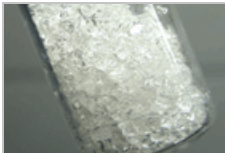
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water.

In 2010, contaminants from such a well bubbled up in a west Los Angeles dog park. Within the past three years, similar fountains of oil and gas drilling waste have appeared in Oklahoma and Louisiana. In South Florida, 20 of the nation's most stringently regulated disposal wells failed in the early 1990s, releasing partly treated sewage into aquifers that may one day be needed to supply Miami's drinking water.

There are more than **680,000 underground waste and injection wells** nationwide, more than 150,000 of which shoot industrial fluids thousands of feet below the surface. Scientists and federal regulators acknowledge they do not know how many of the sites are leaking.

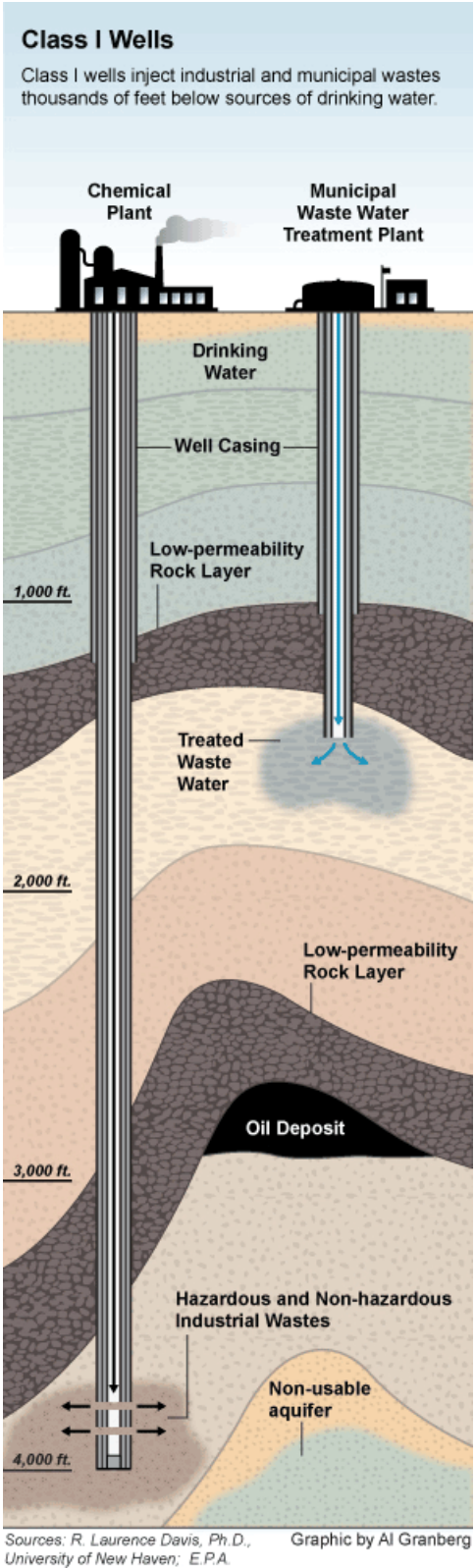
Federal officials and many geologists insist that the risks posed by all this dumping are minimal. Accidents are uncommon, they say, and groundwater reserves — from which most Americans get their drinking water — remain safe and far exceed any plausible threat posed by injecting toxic chemicals into the ground.

But in interviews, several key experts acknowledged that the idea that injection is safe rests on science that has not kept pace with reality, and on oversight that doesn't always work.

"In 10 to 100 years we are going to find out that most of our groundwater is polluted," said Mario Salazar, an engineer who worked for 25 years as a technical expert with the EPA's underground injection program in Washington. "A lot of people are going to get sick, and a lot of people may die."

The boom in oil and natural gas drilling is deepening the uncertainties, geologists acknowledge. Drilling produces copious amounts of waste, burdening regulators and demanding hundreds of additional disposal wells. Those wells — more holes punched in the ground — are changing the earth's geology, adding man-made fractures that allow water and waste to flow more freely.

"There is no certainty at all in any of this, and whoever tells you the opposite is not telling you the truth," said Stefan Finsterle, a leading hydrogeologist at Lawrence Berkeley National Laboratory who specializes in understanding the properties of rock layers and



Sources: R. Laurence Davis, Ph.D., University of New Haven; E.P.A. Graphic by Al Granberg

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modeling how fluid flows through them. "You have changed the system with pressure and temperature and fracturing, so you don't know how it will behave."

A ProPublica review of well records, case histories and government summaries of more than 220,000 well inspections found that structural failures inside injection wells are routine. From late 2007 to late 2010, one well integrity violation was issued for every six deep injection wells examined — more than 17,000 violations nationally. More than 7,000 wells showed signs that their walls were leaking. Records also show wells are frequently operated in violation of safety regulations and under conditions that greatly increase the risk of fluid leakage and the threat of water contamination.

Structurally, [a disposal well is the same as an oil or gas well](#). Tubes of concrete and steel extend anywhere from a few hundred feet to two miles into the earth. At the bottom, the well opens into a natural rock formation. There is no container. Waste simply seeps out, filling tiny spaces left between the grains in the rock like the gaps between stacked marbles.

Many scientists and regulators say the alternatives to the injection process — burning waste, treating wastewater, recycling, or disposing of waste on the surface — are far more expensive or bring additional environmental risks.

Subterranean waste disposal, they point out, is a cornerstone of the nation's economy, relied on by the pharmaceutical, agricultural and chemical industries. It's also critical to a future less dependent on foreign oil: Hydraulic fracturing, "clean coal" technologies, nuclear fuel production and carbon storage (the keystone of the strategy to address climate change) all count on pushing waste into rock formations below the earth's surface.

The U.S. Environmental Protection Agency, which has primary regulatory authority over the nation's injection wells, would not discuss specific well failures identified by ProPublica or make staffers available for interviews. The agency also declined to answer many questions in writing, though it sent responses to several. Its director for the Drinking Water Protection Division, Ann Codrington, sent a statement to ProPublica defending the injection program's effectiveness.

"Underground injection has been and continues to be a viable technique for subsurface storage and disposal of fluids when properly done," the statement said. "EPA recognizes that more can be done to enhance drinking water safeguards and, along with states and tribes, will work to improve the efficiency of the underground injection control program."

Still, some experts see the well failures and leaks discovered so far as signs of broader problems, raising concerns about how much pollution may be leaking out undetected. By the time the damage is discovered, they say, it could be irreversible.

"Are we heading down a path we might regret in the future?" said Anthony Ingraffea, a Cornell University engineering professor who has been an outspoken critic of claims that wells don't leak. "Yes."

In September 2003, Ed Cowley got a call to check out a pool of briny water in a bucolic farm field outside Chico, Texas. Nearby, he said, a stand of trees had begun to wither, their leaves turning crispy brown and falling to the ground.

Chico, a town of about 1,000 people 50 miles northwest of Fort Worth, lies in the heart of Texas' Barnett Shale. Gas wells dot the landscape like mailboxes in suburbia. A short distance away from the murky pond, an oil services company had begun pumping millions of gallons of drilling waste into an injection well.

Regulators refer to such waste as salt water or brine, but it often includes less benign contaminants, including fracking chemicals, benzene and other substances known to cause cancer.

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The well had been [authorized by the Railroad Commission](#) of Texas, which once regulated railways but now oversees 260,000 oil and gas wells and 52,000 injection wells. (Another agency, the Texas Commission on Environmental Quality, regulates injection wells for waste from other industries.)

Before issuing the permit, commission officials studied mathematical models showing that waste could be safely injected into a sandstone layer about one-third of a mile beneath the farm. They specified how much waste could go into the well, under how much pressure, and calculated how far it would dissipate underground. As federal law requires, they also reviewed a quarter-mile radius around the site to make sure waste would not seep back toward the surface through abandoned wells or other holes in the area.

Yet the precautions failed. "Salt water" brine migrated from the injection site and shot back to the surface through three old well holes nearby.

"Have you ever seen an artesian well?" recalled Cowley, Chico's director of public works. "It was just water flowing up out of the ground."

Despite residents' fears that the injected waste could be making its way toward their drinking water, commission officials did not sample soil or water near the leak.

If the injection well waste "had threatened harm to the ground water in the area, an in-depth RRC investigation would have been initiated," Ramona Nye, a spokeswoman for Texas' Railroad Commission, wrote in an email.

The agency disputes Cowley's description of a pool of brine or of dead trees, saying that the waste barely spilled beyond the overflowing wells, though officials could not identify any documents or staffers who contradicted Cowley's recollections. Accounts similar to Cowley's appeared in an article about the leak in the Wise County Messenger, a local newspaper. The agency has destroyed its records about the incident, saying it is required to keep them for only two years.

After the breach, the commission ordered two of the old wells to be plugged with cement and restricted the rate at which waste could be injected into the well. It did not issue any violations against the disposal company, which had followed Texas' rules, regulators said. The commission allowed the well operator to continue injecting thousands of barrels of brine into the well each day. A few months later, brine began spurting out of three more old wells nearby.

"It's kind of like Whac-a-Mole, where one thing pops up and by the time you go to hit it, another thing comes up," Cowley said. "It was frustrating. ... If your water goes, what does that do to the value of your land?"

Deep well injection takes place in 32 states, from Pennsylvania to Michigan to California. Most wells are around the Great Lakes and in areas where oil and gas is produced: along the Appalachian crest and the Gulf Coast, in California and in Texas, which has more wells for hazardous industrial waste and oil and gas waste than any other state.

Federal rules divide wells into six classes based on the material they hold and the industry that produced it. Class 1 wells handle the most hazardous materials, including fertilizers, acids and deadly compounds such as asbestos, PCBs and cyanide. The energy industry has its own category, Class 2, which includes disposal wells and wells in which fluids are injected to force out trapped oil and gas. The most common wells, called Class 5, are a sort of catch-all for everything left over from the other categories, including storm-water runoff from gas stations.

The EPA requires that Class 1 and 2 injection wells be drilled the deepest to assure that the most toxic waste is pushed far below drinking water aquifers. Both types of wells are supposed to be walled with multiple layers of steel tubing and cement and regularly

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monitored for cracks.

Officials' confidence in this manner of disposal stems not only from safety precautions, but from an understanding of how rock formations trap fluid.

Underground waste, officials say, is contained by layer after layer of impermeable rock. If one layer leaks, the next blocks the waste from spreading before it reaches groundwater. The laws of physics and fluid dynamics should ensure that the waste can't spread far and is diluted as it goes.

The layering "is a very strong phenomenon and it's on our side," said Susan Hovorka, a senior research scientist at the University of Texas at Austin's Bureau of Economic Geology.

According to [risk analyses cited in EPA documents](#), a significant well leak that leads to water contamination is highly unlikely — on the order of one in a million.

Once waste is underground, though, there are few ways to track how far it goes, how quickly or where it winds up. There is plenty of theory, but little data to prove the system works.

"I do think the risks are low, but it has never been adequately demonstrated," said John Apps, a leading geoscientist who advises the Department of Energy for Lawrence Berkeley National Labs. "Every statement is based on a collection of experts that offer you their opinions. Then you do a scientific analysis of their opinions and get some probability out of it. This is a wonderful way to go when you don't have any evidence one way or another... But it really doesn't mean anything scientifically."

The hard data that does exist comes from well inspections conducted by federal and state regulators, who can issue citations to operators for injecting illegally, for not maintaining wells, or for operating wells at unsafe pressures. This information is the EPA's primary means of tracking the system's health on a national scale.

Yet, in response to questions from ProPublica, the EPA acknowledged it has done very little with the data it collects. The agency could not provide ProPublica with a tally of how frequently wells fail or of how often disposal regulations are violated. It has not counted the number of cases of waste migration or contamination in more than 20 years. The agency often accepts reports from state injection regulators that are partly blank, contain conflicting figures or are missing key details, ProPublica found.

In 2007, the [EPA launched a national data system](#) to centralize reports on injection wells. As of September 2011 — [the last time the EPA issued a public update](#) — less than half of the state and local regulatory agencies overseeing injection were contributing to the database. It [contained complete information](#) from only a handful of states, accounting for a small fraction of the deep wells in the country.

The EPA did not respond to questions seeking more detail about how it handles its data, or about how the agency judges whether its oversight is working.

In a 2008 interview with ProPublica, one EPA scientist acknowledged shortcomings in the way the agency oversees the injection program.

"It's assumed that the monitoring rules and requirements are in place and are protective — that's assumed," said Gregory Oberley, an EPA groundwater specialist who studies injection and water issues in the Rocky Mountain region. "You're not going to know what's going on until someone's well is contaminated and they are complaining about it."

ProPublica's analysis of case histories and EPA data from October 2007 to October 2010 showed that when an injection well fails, it is most often because of holes or cracks in the well structure itself.

Operators are required to do so-called "mechanical integrity" tests at regular intervals, yearly for Class 1 wells and at least once every five years for Class 2 wells. In 2010, the tests led to more than 7,500 violations nationally, with more than 2,300 wells failing. In Texas, one violation was issued for every three Class 2 wells examined in 2010.

Such breakdowns can have serious consequences. Damage to the cement or steel casing can allow fluids to seep into the earth, where they could migrate into water supplies.

Regulators say redundant layers of protection usually prevent waste from getting that far, but EPA data shows that in the three years analyzed by ProPublica, more than 7,500 well test failures involved what federal water protection regulations describe as "fluid migration" and "significant leaks."

In September 2009, workers for [Unit Petroleum Company](#) discovered oil and gas waste in a roadside ditch in southern Louisiana. After tracing the fluid to a crack in the casing of a nearby injection well, operators tested the rest of the well. Only then did they find another hole — 600 feet down, and just a few hundred feet away from an aquifer that is a source of drinking water for that part of the state.

Most well failures are patched within six months of being discovered, EPA data shows, but with as much as five years passing between integrity tests, it can take a while for leaks to be discovered. And not every well can be repaired. Kansas shut down at least 47 injection wells in 2010, filling them with cement and burying them, because their mechanical integrity could not be restored. Louisiana shut down 82. Wyoming shut down 144.

Another way wells can leak is if waste is injected with such force that it accidentally shatters the rock meant to contain it. A [report published by scientists](#) at the Department of Energy's Pacific Northwest National Laboratory and the University of Texas said that high pressure is "the driving force" that can help connect deep geologic layers with shallower ones, allowing fluid to seep through the earth.

Most injection well permits strictly limit the maximum pressure allowed, but well operators — rushing to dispose of more waste in less time — sometimes break the rules, state regulatory inspections show. According to data provided by states to the EPA, deep well operators have been caught exceeding injection pressure limits more than 1,100 times since 2008.

Excessive pressure factored into a 1989 well failure that yielded new clues about the risks of injection.

While drilling a disposal well in southern Ohio, workers for the Aristech Chemical Corp. (since bought by Sunoco, and sold again, in 2011, to Haverhill Chemicals) were overwhelmed by the smell of phenol, a deadly chemical the company had injected into two Class 1 wells nearby. Somehow, perhaps over decades, the pollution had risen 1,400 feet through solid rock and was progressing toward surface aquifers.

Ohio environmental officials — aided by the EPA — investigated for some 15 years. They concluded that the wells were mechanically sound, but Aristech had injected waste into them faster and under higher pressure than the geologic formation could bear.

Though scientists maintain that the Aristech leak was a rarity, they acknowledge that such problems are more likely in places where industrial activity has changed the underground environment.

There are upwards of 2 million [abandoned and plugged oil and gas wells](#) in the U.S., more than 100,000 of which may not appear in regulators' records. Sometimes they are just broken off tubes of steel, buried or sticking out of the ground. Many are supposed to be sealed shut with cement, but studies show that cement breaks down over time, allowing seepage up the well structure.

Also, if injected waste reaches the bottom of old wells, it can quickly be driven back toward aquifers, as it was in Chico.

"The United States looks like a pin cushion," said Bruce Kobelski, a geologist who has been with the agency's underground injection program since 1986. Kobelski spoke to ProPublica in May, 2011, before the EPA declined additional interview requests for this story. "Unfortunately there are cases where someone missed a well or a well wasn't indicated. It could have been a well from the turn of the [20th] century."

Clefts left after the earth is cracked open to frack for oil and gas also can connect abandoned wells and waste injection zones. How far these man-made fissures go is still the subject of research and debate, but [in some cases](#) they have reached as much as a half-mile, even [intersecting fractures](#) from neighboring wells.

When injection wells intersect with fracked wells and abandoned wells, the combined effect is that many of the natural protections assumed to be provided by deep underground geology no longer exist.

"It's a natural system and if you go in and start punching holes through it and changing pressure systems around, it's no longer natural," said Nathan Wiser, an underground injection expert working for the EPA in its Rocky Mountain region, in a 2010 interview. "It's difficult to know how it would behave in those circumstances."

EPA data provides a window into some injection well problems, but not all. There is no way to know how many wells have undetected leaks or to measure the amount of waste escaping from them.

In at least some cases, records obtained by ProPublica show, well failures may have contaminated sources of drinking water. Between 2008 and 2011, state regulators reported 150 instances of what the EPA calls "cases of alleged contamination," in which waste from injection wells purportedly reached aquifers. In 25 instances, the waste came from Class 2 wells. The EPA did not respond to requests for the results of investigations into those incidents or to clarify the standard for reporting a case.

The data probably understates the true extent of such incidents, however.

Leaking wells can simply go undetected. [One Texas study](#) looking for the cause of high salinity in soil found that at least 29 brine injection wells in its study area were likely sending a plume of salt water up into the ground unnoticed. Even when a problem is reported, as in Chico, regulators don't always do the expensive and time-consuming work necessary to investigate its cause.

"The absence of episodes of pollution can mean that there are none, or that no one is looking," said Salazar, the EPA's former injection expert. "I would tend to believe it is the latter."

The practice of injecting waste underground arose as a solution to an environmental crisis.

In the first half of the 20th century, toxic waste collected in cesspools, or was dumped in rivers or poured onto fields. As the consequences of unbridled pollution became unacceptable, the country turned to an out-of-sight alternative. Drawing on techniques developed by the oil and gas industry, companies started pumping waste back into wells drilled for resources. Toxic waste became all but invisible. Air and water began to get cleaner.

Then a host of unanticipated problems began to arise.

In April, 1967 pesticide waste injected by a chemical plant at Denver's Rocky Mountain Arsenal destabilized a seismic fault, [causing a magnitude 5.0 earthquake](#) — strong enough to shatter windows and close schools — and jolting scientists with newfound

risks of injection, according to the U.S. Geological Survey.

A year later, a corroded hazardous waste well for pulping liquor at the Hammermill Paper Co., in Erie, Pa., ruptured. Five miles away, [according to an EPA report](#), "a noxious black liquid seeped from an abandoned gas well" in Presque Isle State Park.

In 1975 in [Beaumont, Texas](#), dioxin and a highly acidic herbicide injected underground by the [Velsicol Chemical Corp.](#) burned a hole through its well casing, sending as much as five million gallons of the waste into a nearby drinking water aquifer.

Then in August 1984 in Oak Ridge, Tenn., [radioactive waste was turned](#) up by water monitoring near a deep injection well at a government nuclear facility.

Regulators raced to catch up. In 1974, the Safe Drinking Water Act was passed, establishing a framework for regulating injection. Then, in 1980, the EPA set up the tiered classes of wells and began to establish basic construction standards and inspection schedules. The EPA licensed some state agencies to monitor wells within their borders and handled oversight jointly with others, but all had to meet the baseline requirements of the federal Underground Injection Control program.

Even with stricter regulations in place, 17 states — including Alabama, North Carolina, South Carolina and Wisconsin — [banned Class 1 hazardous deep well injection](#).

"We just felt like based on the knowledge that we had at that time that it was not something that was really in the best interest of the environment or the state," said James Warr, who headed Alabama's Department of Environmental Management at the time.

Injection accidents kept cropping up.

A [1987 General Accountability Office review](#) put the total number of cases in which waste had migrated from Class 1 hazardous waste wells into underground aquifers at 10 — including the Texas and Pennsylvania sites. Two of those aquifers were considered potential drinking water sources.

In 1989, [the GAO reported 23 more cases](#) in seven states where oil and gas injection wells had failed and polluted aquifers. New regulations had done little to prevent the problems, the report said, largely because most of the wells involved had been grandfathered in and had not had to comply with key aspects of the rules.

Noting four more suspected cases, the report also suggested there could be more well failures, and more widespread pollution, beyond the cases identified. "The full extent to which injected brines have contaminated underground sources of drinking water is unknown," it stated.

The GAO concluded that most of the contaminated aquifers could not be reclaimed because fixing the damage was "too costly" or "technically infeasible."

Faced with such findings, the federal government drafted more rules aimed at strengthening the injection program. The government outlawed certain types of wells above or near drinking water aquifers, mandating that most industrial waste be injected deeper.

The agency also began to hold companies that disposed of hazardous industrial waste to far stiffer standards. To get permits to dispose of hazardous waste after 1988, companies had to prove — using complex models and geological studies — that the stuff they injected wouldn't migrate anywhere near water supplies for 10,000 years. They were already required to test for fault zones and to conduct reviews to ensure there were no conduits for leakage, such as abandoned wells, within a quarter-mile radius. Later, that became a two-mile minimum radius for some wells.

The added regulations would have prevented the vast majority of the accidents that occurred before the late 1980s, EPA officials contend.

"The requirements weren't as rigorous, the testing wasn't as rigorous and in some cases the shallow aquifers were contaminated," Kobelski said. "The program is not the same as it was when we first started."

Today's injection program, however, faces a new set of problems.

As federal regulators toughened rules for injecting hazardous waste, oil and gas companies argued that the new standards could drive them out of business. State oil and gas regulators pushed back against the regulations, too, saying that enforcing the rules for Class 2 wells — which handle the vast majority of injected waste by volume — would be expensive and difficult.

Ultimately, the energy industry won a critical change in the federal government's legal definition of waste: [Since 1988, all material resulting from the oil and gas drilling process](#) is considered non-hazardous, regardless of its content or toxicity.

"It took a lot of talking to sell the EPA on that and there are still a lot of people that don't like it," said Bill Bryson, a geologist and former head of the Kansas Corporation Commission's Conservation Division, who lobbied for and helped draft the federal rules. "But it seemed the best way to protect the environment and to stop everybody from just having to test everything all the time."

The new approach removed many of the constraints on the oil and gas industry. They were no longer required to conduct seismic tests (a stricture that remained in place for Class 1 wells). Operators were allowed to test their wells less frequently for mechanical integrity and the area they had to check for abandoned wells was kept to a minimum — one reason drilling waste kept bubbling to the surface near Chico.

Soon after the first Chico incident, Texas expanded the area regulators were required to check for abandoned waste wells (a rule that applied only to certain parts of the state). Doubling the radius they reviewed in Chico to a half mile, they found 13 other injection or oil and gas wells. When they studied the land within a mile — the radius required for review of many Class 1 wells — officials discovered another 35 wells, many dating to the 1950s.

The Railroad Commission concluded that the Chico injection well had overflowed: The target rock zone could no longer handle the volume being pushed into it. Trying to cram in more waste at the same speed could cause further leaks, regulators feared. The commission set new limits on how fast the waste could be injected, but did not forbid further disposal. The well remains in use to this day.

In late 2008, samples of Chico's municipal drinking water were found to contain radium, a radioactive derivative of uranium and a common attribute of drilling waste. The water well was a few miles away from the leaking injection well site, but environmental officials said the contaminants discovered in the water well were unrelated, mostly because they didn't include the level of sodium typical of brine.

Since then, Ed Cowley, the public works director, said commission officials have continued to assure him that brine won't reach Chico's drinking water. But since the agency keeps allowing more injection and doesn't track the cumulative volume of waste going into wells in the area, he's skeptical that they can keep their promise.

"I was kind of like, 'You all need to get together and look at the total amount you are trying to fit through the eye of the needle,'" he said.

When sewage flowed from 20 [Class 1 wells near Miami](#) into the Upper Floridan aquifer, it challenged some of scientists' fundamental assumptions about the injection system.

The wells — which had helped fuel the growth of South Florida by eliminating the need for expensive water treatment plants — had passed rigorous EPA and state evaluation

throughout the 1980s and 1990s. Inspections showed they were structurally sound. As Class 1 wells, they were subject to some of the most frequent tests and closest scrutiny.

Yet they failed.

The wells' designers would have calculated what is typically called the "zone of influence" — the space that waste injected into the wells was expected to fill. This was based on estimates of how much fluid would be injected and under what pressure.

In drawings, the zone of influence typically looks like a Hershey's kiss, an evenly dispersed plume spreading in a predictable circular fashion away from the bottom of the well. Above the zone, most drawings depict uniform formations of rock not unlike a layer cake.

Based on modeling and analysis by some of the most sophisticated engineering consultants in the country, Florida officials, with the EPA's assent, concluded that waste injected into the Miami-area wells would be forever trapped far below the South Florida peninsula.

"All of the modeling indicated that the injectate would be confined in the injection zone," an EPA spokesperson wrote to ProPublica in a statement.

But as Miami poured nearly half a billion gallons of partly treated sewage into the ground each day from the late 1980s through the mid 1990s, hydrogeologists learned that the earth — and the flow of fluids through it — wasn't as uniform as the models depicted. Florida's injection wells, for example, had been drilled into rock that was far more porous and fractured than scientists previously understood.

"Geology is never what you think it is," said Ronald Reese, a geologist with the United States Geological Survey in Florida who has studied the well failures there. "There are always surprises."

Other gaps have emerged between theories of how underground injection should work and how it actually does. Rock layers aren't always neatly stacked as they appear in engineers' sketches. They often fold and twist over on themselves. Waste injected into such formations is more likely to spread in lopsided, unpredictable ways than in a uniform cone. It is also likely to channel through spaces in the rock as pressure forces it along the weakest lines.

Petroleum engineers in Texas have found that when they pump fluid into one end of an oil reservoir to push oil out the other, the injected fluid sometimes flows around the reservoir, completely missing the targeted zone.

"People are still surprised at the route that the injectate is taking or the bypassing that can happen," said Jean-Philippe Nicot, a research scientist at the University of Texas' Bureau of Economic Geology.

Conventional wisdom says fluids injected underground should spread at a rate of several inches or less each year, and go only as far as they are pushed by the pressure inside the well. In some instances, however, fluids have traveled faster and farther than researchers thought possible.

In a [2000 case](#) that wasn't caused by injection but brought important lessons about how fluids could move underground, hydrogeologists concluded that bacteria-polluted water migrated horizontally underground for several thousand feet in just 26 hours, contaminating a drinking water well in Walkerton, Ontario, and sickening thousands of residents. The fluids traveled 80 times as fast as the standard software model predicted was possible.

According to the model, vertical movement of underground fluids shouldn't be possible at all, or should happen over what scientists call "geologic time": thousands of years or longer. Yet a [2011 study in Wisconsin](#) found that human viruses had managed to

infiltrate deep aquifers, probably moving downward through layers believed to be a permanent seal.

According to a study published in [April in the journal Ground Water](#), it's not a matter of if fluid will move through rock layers, but when.

Tom Myers, a hydrologist, drew on research showing that natural faults and fractures are more prevalent than commonly understood to create a model that predicts how chemicals might move in the Marcellus Shale, a dense layer of rock that has been called impermeable. The Marcellus Shale, which stretches from New York to Tennessee, is the focus of intense debate because of concerns that chemicals injected in drilling for natural gas will pollute water.


Myers' new model said that chemicals could leak through natural cracks into aquifers tapped for drinking water in about 100 years, far more quickly than had been thought. In areas where there is hydraulic fracturing or drilling, Myers' model shows, man-made faults and natural ones could intersect and chemicals could migrate to the surface in as little as "a few years, or less."

"It's out of sight, out of mind now. But 50 years from now?" Myers said, referring to injected waste and the rock layers trusted to entrap it. "Simply put, they are not impermeable."

Myers' work is among the few studies done over the past few decades to compare theories of hydrogeology to what actually happens. But even his research is based on models.

"A lot of the concepts and a lot of the regulations that govern this whole practice of subsurface injection is kind of dated at this point," said one senior EPA hydrologist who was not authorized to speak to ProPublica, and declined to be quoted by name.

"It's a problem," he said. "There needs to be a hard look at this in a new way."


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96 comments

Joe Metras
June 21, 10:59 a.m.

Smart , aggressive regulation designed by the EPA (which at it's top ranks is basically a liberal environmental group), will make fracking a much less environmentally risky endeavor. The industry for the most part invites the regulation because they will make a great deal of money as America shifts from foreign oil to a combination of natural gas and alternative energy. One enables the other - without peaking natural gas power plants that can be fired up and down quickly, alternatives are not viable because of the variability in power

production. Gas makes alternatives work. Gas allows us to limit our involvement in the middle east and takes money away from terrorists who are funded by oil profits. Gas will allow us to cut emissions dramatically over the next 20 years. Cheap gas makes american industry more profitable allowing for growth in manufacturing as labor costs in china go up and production costs in the US go down.

The status quo makes us beholden to the middle east, hurts our ability to compete in manufacturing, and potentially ruins the entire planet through acceleration of global warming.

I think environmentalists need to lose the battle to win the war. Limited contamination from fracking is a terrible thing, but far less terrible than worldwide destruction wrought by global warming. Eventually our energy storage technology will advance to the point where we can get off of natural gas as well and go to 100% alternatives. But in the intervening 20 years, a little dose of reality would go a long way. Environmentalists should be leading the fight to make sure fracking is regulated properly and people harmed by it compensated appropriately. Similarly they should be fighting for research dollars to fund energy storage technology. But simply opposing the least worst option on moral grounds makes environmentalists a big cause of the REAL problem rather than leading the way towards a solution.

Chip Northrup June 21, 1:34 p.m.	<p>Good article.</p> <p>Any wellbore can leak - from the outside of the outermost casing - and become a pathway for gas from any gas bearing strata to go up into groundwater.</p> <p>The wellbore does not have to be a gas well. An injection well will do just fine.</p> <p>http://www.scribd.com/doc/65577477/How-Gas-Wells-Leak</p>
pete kliosares June 21, 4:14 p.m.	<p>read</p>
Joe Brown June 21, 4:47 p.m.	<p>Even if the drillers were actually regulated, monitored, and made to compensate property owners, what happens to public land that is being drilled, and how do they compensate for the illnesses and/or death that is the result of their drilling for oil and gas?</p> <p>It's easy to hope that the various governmental bodies will protect the public, but once the damage is done to health and to the environment, there is nothing that can be done to undo that damage.</p>
bjean June 21, 4:48 p.m.	<p>Very scary stuff!! Thank you, ProPublica for a thorough, well-written article.</p>
JimmyCracksCapricorns June 21, 7:18 p.m.	<p>Meanwhile, and all the while, American Industry has kept us entertained and distracted with movies, video games, fast and fancy cars, smart phones, internet(s), fast food, and cheap airfares....pay no never mind what we do with all the sludge, gludge, toxic residues, dioxins, and heavy metals we spill, drill, pour, shore, and bore into the earth...</p> <p>You just sit right there and enjoy that new thing-a-ma-jig you bought from us and watch that henny penny share of stock in your 401k go up!-D</p>
lorraine June 21, 7:51 p.m.	<p>What next, pair this with fracking?</p>
Shahislam June 21, 8:35 p.m.	<p>Scared group of scientists with those human stamped certifications know very little, so no one should feel worried over non-sense chemical related issues. Just move to safer sites and cities.</p>
Alma Hasse	<p>EXCELLENT ARTICLE! Every lawmaker and regulator—at every level of</p>

June 21, 11:43 p.m. government—should be required to read this!

Georgina Byrne
June 22, 12:55 a.m. Wow Shahislam, where would those safer sites and cities be then? The USA leads, the rest of the world follows...in spades!

Melody Carranza
June 22, 1 a.m. It isn't enough that we're poisoning the air and ocean, now we're injecting our filth into the soil. It's ironic that the people that don't want to hear about the environment are the ones over populating the earth with their children. Yes... you are great parents, leaving your kids an earth on the verge of explosion.

ibsteve2u
June 22, 1:38 a.m. "In 10 to 100 years we are going to find out that most of our groundwater is polluted," said Mario Salazar...

Yeah, but the people who got rich doing it are going to be dead - a fact they knew going it.

That is the sum total of the right's - and face it, Big Carbon, Wall Street, Corporate America, and Big Banking define and control "the right" - ethical system: "I'll get rich today, and somebody else can worry about tomorrow!".

Is why I think America - the world - should have a book like England's "Doomsday Book", but a book focused on recording the names of the industrialists, investors, legislators/politicians, and regulators who enriched themselves poisoning the world's tomorrow.

You know, so that the planet's survivors might have a...conversation...with any of their descendents who still thrive on the wealth harvested through such acts of destruction? Very Biblical; sins of the fathers, and all that.

Shahislam
June 22, 2:35 a.m. @ Georgina,
You are right and I am not wrong either. Our North-America will remain the best because of humans like you and me.
Somewhere in <http://WWW.shahislam.com> you may find some clue if you be kind and interested.

Georgina
June 22, 4:36 a.m. Hello Shahislam, I am certainly interested and try to be kind... but although I lived in Boston Mass. for 5 years, I am Australian and live in Western Australia, which, as far as I know, has not employed such technology as yet. However, given that our Governments both State and Federal seem to be hell bent on copying the worst of America's excesses, I'm sure it'll come here...CSG is already wrecking some of the best farmland and public land to the east of my country It's also threatening the Great Artesian basin, one of the largest on the planet...Farmers like me and those who give a damn, have a hell of a fight on their hands with the miners right now. In any case, it's all the same planet and the only one we have to support us, isn't it!

Stephanie Palmer
June 22, 7:42 a.m. Hey, what's the matter with you? There's money to be made. The Congress and the state legislatures all agree to this injection. And the citizens keep electing the same congress and legislatures, so clearly they don't actually mind the money makers destroying the very basics of life. They actually believe that it wont hurt them. We will eventually all die from one thing or another, why not die so someone can make a lot of money? Then all the voters will say, well, I didn't know as if that were something beyond their control.

ibsteve2u
June 22, 8:25 a.m. That's a little *too* sarcastic, Stephanie. The voters elect a face who doesn't mention the fact that he or she will cave if approached by a lobbyist or a political donor with a pocketful of loot.

America's problem is money changes people...until we isolate our government from the influence of money, it doesn't matter if we "throw the bums out" every election. In fact, I would predict that would *increase* the amount of corruption as the lawmaker won't have the thought "I could always take the money the *next* time." reinforcing their conscience if they know that they're only going to

get one shot at the big money.

Of course, if somebody invents a hat that lights up when a politician lies or takes part in an act of corruption...we'd probably eliminate political corruption, but at a minimum we wouldn't have to pay a lighting bill in our national and state seats of government anymore.

sumner
June 22, 9:53 a.m.

I think this is a great article.

A reply to Joe Metras: Yes, it would be convenient and helpful to use peaking natural gas plants to support a number of developed and developing renewable, truly clean sources of energy; but I think it's wrong to think that the emissions from fracking-based natural gas will have much less of an impact regarding global warming. There's a growing concern over the effects from fugitive air emissions from all stages in the lifecycle of producing fracked gas. There are many ways that gas is released to the atmosphere; and at least some of this gas is methane, which by volume or mass is a much more potent greenhouse gas than carbon dioxide. Pick your poison!

John
June 22, 12:14 p.m.

I'll just repeat what I usually say about natural gas stories: Gosh, it's a shame that the only way to get methane is by finding rare deposits and using enormous equipment to pump it out. Yep, a crying shame that there isn't some organic, biological way to get methane as a product of, say, burning garbage or bacterial digestion...

I'm in favor of natural gas, but I'm against fracking in the same way I'd be against an approach to solar power that required building a ladder to the sun. Sure, you could try it, but it seems like a waste, when the stuff's all around us.

Of course, the economy is built around the idea of scarcity, so that makes it hard to justify to the board of directors drawing attention to the fact that any idiot can generate enough gas for his car nearly free. Wikipedia has a decent article on Wood Gas. Searching for Biomass Gasification also turns up some interesting articles at the hobbyist level.

And I'm sure there's some symbolic satisfaction to drilling into Mother Earth to ejaculate toxic waste into her cavities in a totally-not-overcompensating-for-something kind of way.

Doug Vass
June 22, 12:19 p.m.

These are just chemicals and therefore as chemicals they should be mixed with other chemicals until they can be made inert and this before injection into the earth. This should be mandated and inspected so that those who do inject chemicals can't take shortcuts. we sit around and use the reasoning "that we are ruining things for future generations" well, this reasoning should be applied here as well as a number one priority. Humans and plants can't live without water, clean water.

Sherman
June 22, 12:58 p.m.

Pin cushion indeed!

The process of horizontal gas extraction is extremely wasteful, and leaves behind toxins that may not break down for centuries.

Water wars are nearly upon us, yet this industry is going strong, polluting huge amounts of potential drinking or farming water to reach their extraction goals.

Too bad this does not represent a huge chunk of operating costs. If that were the case, a few heads would get moving on research to find alternate methods to change parameters.

Will Koop
June 22, 1:17 p.m.

Thanks, ProPublica, for publishing this piece. As a result of a series of environmental-based legislations passed in 1969 and on into the 1970s, by the 1980s the U.S. petroleum industry and US regulators came under intense scrutiny re problematic activities on dealing with immense stockpiles of petroleum waste (activities, mind you, being conducted world-wide). The petroleum politics and related lobbying about the disposal of these toxic stockpiles were, shall we say, intense. The Alaska Center for the Environment ended up suing the EPA in 1985 to get its ass moving on assessing and

regulating these toxics, and the EPA, as a result, eventually releasing a December 28, 1987 report to Congress, "Management of Wastes from the Exploration, Development, and Production of Crude Oil, Natural Gas, and Geothermal Energy." At the same time in the 1980s, when unconventional fracking experiments were co-conducted in Alabama and in Colorado/New Mexico, it was all hush hush on the liability front related to well-bore integrity and leaking gases and fluids. What did the EPA report on July 6, 1988: regulations on oil and gas hazardous wastes "would cause a severe economic impact on the industry and oil and gas production in the U.S." It's utterly mind-boggling as to what has been cumulatively sanctioned with regard to the underground disposals of these wastes over the last 30 odd years, and how professionals in the petroleum industry have managed to dodge the proverbial ball. In attempting to trace and address some of this related history, here's a link to the chapter "(Wellbore) Integrity on Trial - The Liability Nightmare" - from a report I published in January, 2012, <http://www.bctwa.org/FrkPol-16-Chap14.pdf> (many thanks to those I interviewed and those that offered their helpful services in writing this chapter).

DLS
June 22, 1:26 p.m.

A lot of this information seems to be a repetition of facts compiled by Josh Fox. What I do not see is his name anywhere.

Fractalman
June 22, 2:22 p.m.

Yikes! You guys sure do have your panties in a wad! As the only one on this site, so far, from the evil oil and gas industry, let me try to give you some perspective. So many things to address but here's just a couple.

Yes, since my industry began in the 1860's, much has been learned in 150 years of doing business. There are old wells (late 19th century to early 20th century) out there that were plugged using the best available technology at the time. IF they are in close enough proximity to an injection well, they have been known to communicate with the injection well and leak. When they are discovered to be leaking they are re-entered and filled with cement from top to bottom, solid cement. What leakage that does occur is quite small relatively speaking and Mother Earth has a remarkable ability to remedy and cleanse herself over time.

The tests that the article refers to for injection wells are called Mechanical Integrity Tests, or "MIT's" for short. If a well fails an MIT, the operator of the well is required to remedy the reason for the failure or plug the well, which usually means squeezing cement over the failure intervals or plugging the well with cement throughout. Injection wells can be fixed to where they pass the MIT. The article fails to mention this.

I would support a minimum depth for injection below the known fresh water depth. As an operator I would want to be satisfied that there was enough rock between my injection zone and the fresh water. I am a geologist and I doubt if any of the previous commenters are, but I don't think you appreciate just how hard and impenetrable most rock is. If a layer of rock just a few feet thick can provide a seal for an oil/gas reservoir, don't you think several thousand feet of rock is pretty good insurance against fluids migrating up into the surface waters?

As for "fracking", or hydraulic fracturing, techniques, unless they are performed within just a few hundred feet or less below a freshwater zone, the chances of fracking up into the fresh water are virtually nil. Engineers commonly refer to something called "frac height" which is a number that calculates how high the fractures created may reach and it derives, simply put, from horsepower applied, fluid used, and mechanical strength of the rock (which is measured). I think most of you think of a frack job as akin to a nuclear device exploding underground when the more apt analogy is a pebble thrown into large pond whereupon the ripples die out within 10-20 feet of its impact. All a frack job is is energy introduced into the depths of the earth that dissipates within a very short distance of its introduction. You guys must think it works like light or something!

Willie Fontenot
June 22, 4:05 p.m.

Dear Pro Publica,
Thank you for the excellent article about some of the problems and challenges

connected with the underground injection of waste.

Many of the problems have not surfaced yet and even your article does not present some of the details which help to tell this story.

You mention the disaster in 1968 when waste from the Hammermill Paper Company showed up on Presque Isle some five miles from the injection well. What you did not mention is that Presque Isle is miles away from land out in Lake Erie

If hazardous waste from a paper mill can travel five miles under Lake Erie and not be noticed until it travels up an improperly plugged old ol well then almost anything is possible.

Your article mentions that more than 600,000 injection wells have been used around the USA. This comes to more than n average of 10,000 wells per state.

You also did not mention the long list of other problems which have contaminated surface and ground water besides injection wells like garbage and industrial waste landfills, incinerators, waste pits and lagoons, leaking tanks, pipelines and many others like illegal disposal of toxic and hazardous materials like radioactive materials.

The BP oil disaster in the Gulf of Mexico last year clearly show that more than injection wells acan cause widespread problems which are little understood and which will be playing out for the next few decades.

Again thank you for an excellent article.

John
June 22, 4:25 p.m.

Fractalman, I don't think it's the potential to do it right that's an issue, or a mistaken understanding of science. It's the evidence of companies like Exxon and BP that have shown a pathological disinterest in doing things right when it might affect the shareholders.

The odds of an automobile accident, after all, are also virtually nil. But that assumes that every driver maintains his car, drives according to the law and common sense, and pays attention to what he and his fellow drivers are doing. Outside of that fantasy, however, the percentage of accidents is substantially higher than nil. As they say, the difference between theory and practice is bigger in practice than in theory.

Likewise, people are reporting problems concurrent with wells. It may be impossible in the fantasy, but it's happening.

Rob Knihnicky
June 22, 4:37 p.m.

I think that we should all stop using cars and go back to living in grass huts. Eventually there will be enough death and disease to eliminate most of the human race and the animals will be happy again. Bacon wrapped scallops and filet mignon will become things of the past.

Fractalman
June 22, 4:57 p.m.

John, I acknowledge that there are problems, but your characterization that BP, or ExxonMobil, or any other company shows a "pathological disinterest in doing things right when it might affect shareholders" reveals you are probably an Occupy sympathizer. You obviously are not a businessman or you would know that to have/hold such an attitude invites lawsuits which are definitely not in the interest of shareholders. Every oilman I know lives in fear of being sued and therefore exercises the greatest care possible to avoid practices/accidents that might result in a lawsuit. That goes for the "big boys", too. Lawyers do nothing but suck off the bottom line of companies and it's hard enough to make a profit without that happening.

Thanks for bringing up the automobile, John. I suggest all you folks who like to criticize and condemn those who work honestly within the law to provide your energy to stop driving and stop flying. That will dampen demand, lower prices, and put many of us out of business.

David Kauber
June 22, 7:51 p.m.

Lawyers are a part of the overhead of The Industry and do their part in keeping the honest, real complaints from costing The Industry very much. Usually this works, but occasionally some big event happens, and The Industry has to

cough up some dough(\$\$\$\$\$) to pay off some injured party.

The cost of all these fine inventions of civilization is to isolate the earthlings from WHERE IT ALL COMES FROM. Where does it ALL come from, anyway?
? Most people don't know, nor do most people want to know. And they don't want to know where the "waste" goes, either.

The sad part is that the people who run The Industry are all the more isolated, and greedy enough so as to go for the bucks in hand, and ignore their Life on earth. And they act as if they don't have children, and don't have to have some concern for the future of this planet.

This is the challenge to hold this whole contradiction of civilization to account.

Make it a game, so that it does not cost you all the joy and mystery of being alive, while opposing all those who are hell-bent on destroying the biosphere.

The current hydrofracking of many parts of the planet, is revealing so much of its being US EARTHLINGS vs. THE INDUSTRY.

Stay tuned..... David Kauber

E June 22, 10:51 p.m.	Who needs fictional horror movies for entertainment? Instead, lets Poison the planet and destroy every living thing all at once. All the while blinded by profit. And we consider ourselves superior human beings. No other living creature is as destructive.
ibsteve2u June 22, 11:38 p.m.	All of the "mechanical integrity tests" are reliant upon one premise: Once in place and validated, nothing changes mechanically...forever. Thank God this planet doesn't have marsquakes.
ibsteve2u June 22, 11:41 p.m.	Speaking of water wars...is folks who focus as hard on water rights as they focus on buying mineral rights for fracking. Consider T. Boone Pickens... nebraska.statepaper.com/vnews/display.v/ART/2011/03/12/4d79ede36d5b5 Feller must think the value of clean water is only going to increase.
Robert Earl June 23, 6:10 a.m.	This message is for Abrahm Lustgarten. You say that the pressures employed in this diabolic method of disposal are (much?)less than used in fracking. What is the usual range of pressures used for these disposal wells. Early experiments with disposal in wells near Denver in the 70's employed pressures similar to what is now used in fracking. Of course, this resulted in a series of increasingly strong earthquakes. Thank you for the great reporting, Robert
Sherman June 23, 1:19 p.m.	Yes, yes! finally mentioned is the earth moving. This may yet prove a false premise at the bottom of ridding major corporations of their waste products at the expense of the deep realms of unknown movement and activity. With a warming atmosphere, glacial ice continues to melt, and this is/will be changing the bearing weight on continental plates in certain areas of the globe (physics 101). The ring of fire is fairly active, as evidenced by Christ Church, Japanese tsunami, Chile and what is scary is that it is now active around the globe in other places like Mt. Aetna, Northern Italy, and under-reported events in China, so how can anyone still "assume" that dumping way underground will remain the "right thing to do" going forward? The US may simply have been lucky in the past.

How about using less toxic chemicals and less quantity of these to being with? Once toxins have been diluted in massive amounts of water, it is much more difficult to clean the water.

Upwards of 60,000 new chemicals have been introduced into the environment since the end of WWII, and I bet no one person has a handle on effects these are already causing and will continue to cause in the future.

Although not totally relevant to turn back the clock to living in caves and grass huts, if we keep going in the same “developed nation” direction, this too may occur.

Kevin Rodela
June 23, 6:08 p.m.

All of these chemicals come out of the earth and are simply being returned to the earth. We forget that one volcano releases way more toxins that decades of industrial pollutants. All of the prognosticators were wrong about the how the salmon populations would be adversely affected by the Exxon Valdez spell. The exact opposite happened. Salmon populations and salmon fisherman flourished. They were also wrong about the effects of the Alyaska Pipeline on the caribou herds which have benefitted from it. These “experts” like Salazaar who has probably work for the government most of his life want to stop progress becasue of what may happen. I think that we have a bunch of busy bodies with nothing better to do than to disrupt prosperity. Maybe we would just all be better off working in the rice patties for 15 hour per day like the Kmir Rouge had everyone in Cambodia doing without any machinery. They were also at full employment.

ibgaray2me
June 23, 6:55 p.m.

In response to Joe Metras. I hear such lame rationalizations of “company-speak” so often, and its more social pathology than insightful commentary. No, Joe, the rest of us do not need yet one more “dose of reality” about the thousands of failing injection wells poisoning aquifers and sickening innocent people. We do not need your diabolical public relations propaganda. The fact is, the fuels derived from these wells, along with the tar sands and black gold from off-shore wells in Alaska and elsewhere in the US will be EXPORTED to places such as Japan and China where it brings the highest price. It won't give us any energy security, because we won't benefit from most of it. It is time to stop the madness and get out of the fossil game now. Global climatic warming is real and now. We just need to stop Big Carbon and their lapdogs—such as yourself.

ibsteve2u
June 23, 7:22 p.m.

List of proposed LNG export terminals:
<http://www.ferc.gov/industries/gas/indus-act/lng/LNG-proposed-potential.pdf>

ibsteve2u
June 23, 7:26 p.m.

Pretty easy to guess who will be capable of paying “the highest price”. Seeing as how you have to make *something* to maintain income, it probably *won't* be the country that exported its industrial infrastructure in order to make a few richer faster while hurting “labor” - organized, in particular.

Philip Perlman
June 24, 2:34 a.m.

This article should be sent to every US and State legislator.

gabriel k
June 24, 4:54 a.m.

a smell of a new “ Irene Brockovich ” story might appears but life is not Hollywood. mankind keeps destroying the biosphere despite “ expert's of interest trying to cover up the truth. we need a new Science that overcomes that immense threat to the present and future well being of humanity.it is not just USA problem .this is the results of 250 years of irisposable industrial revolution so far.

Tom
June 24, 7:39 a.m.

As I have written before, the New York drilling contingency is presently being held at bay, only due to the relentlessly diligent efforts of Maya K. van Rossum, and delawariverkeeper.org

Fracking will ultimately destroy the aquifers that sustain all human life, even more than the BP oil spill has destroyed marine life in the gulf. Fracking needs

to be banned forever everywhere, not regulated, and not kept alive with pandering to political bargaining entities who control funding and propaganda to their constituents and their union members.

Sherman June 24, 10:43 a.m.	<p>It is Erin Brocovich, not Irene, in case anyone is keeping track.</p> <p>Volcanos are at extremely high temperatures that would break down nearly all soil toxins, and spew out massive amounts of other gaseous toxins, depending on the type of volcano. But earthquakes are different, and fracking is causing these events regularly.</p> <p>The sick part is US gas and oil concerns are mostly exporting the excess natural gas being extracted using these methods to the highest bidders. Most is going overseas. So this is Not-for-Reducing our dependence for foreign oil, rather it can be viewed as environmental damage for profit.</p>
Elmer Stephens June 24, 9:52 p.m.	<p>Avery good article however it failed to state the size of these wells. Sewerage wells are 36 to 48 inches .</p>
DN Merrill June 25, 2:59 a.m.	<p>Pure insanity. Another disaster poisoning our drinking water. Whomever came up with this idea should be jailed along with the loon who developed hydraulic fracturing.</p>
cmh June 25, 7:57 a.m.	<p>A good article. You might want to review the part about: "Since 1988, all material resulting from the oil and gas drilling process is considered non-hazardous, regardless of its content or toxicity." The change provides an exemption only from RCRA Subtitle C regulations, and the wastes produced might still be subject to other federal or state regulations. Mind you, I am not defending the change in regulations or industry practices, just pointing it out for the sake of accuracy. I think it would be accurate to say we have another example of the EPA caving in to create regulations that are open to some very loose interpretation on the part of industry operators - which is great for them if there is ever a problem later on. Endless years of litigation anyone?</p>
Fractalman June 25, 10:17 a.m.	<p>There is no doubt that pollution events occur in a highly industrialized culture and they occur in primitive cultures, too, just on a smaller and primitive scale. If hydraulic fracturing techniques are "outlawed", or regulated to the point of making them too expensive to employ, you will see oil and gas prices "necessarily skyrocket" (to borrow a phrase from The One). So I don't expect any of you to complain when gasoline costs \$10/gal, or your home heating bill exceeds your mortgage, or only the sainted environmental celebrities (algore) can afford to fly to visit family.</p>
ibsteve2u June 25, 10:34 a.m.	<p>@Fractalman, who emoted: "So I don't expect any of you to complain when gasoline costs \$10/gal, or your home heating bill exceeds your mortgage, or only the sainted environmental celebrities (algore) can afford to fly to visit family."</p> <p>http://cleanenergy.harvard.edu</p> <p>Beats being the generation that killed off all future generations.</p>
Zoe George June 25, 11:43 a.m.	<p>If the regulators and experts cannot enforce the regulations and monitor compliance in the richest nation in the world, what hope does a place like South Africa have to prevent contamination of its aquifers by negligence and unlawful behaviour?</p> <p>I never fail to be amazed by how the country which boasts of being the best of, and at, everything, is, in fact, less competent and responsible than many "third world" nations.</p>
John	<p>Fractalman, I appreciate that this is an emotional issue to you, but making</p>

June 25, 1 p.m. baseless accusations about what kind of future I want and what I do for a living make you look kind of foolish.

Deepwater was documented as “a nightmare,” remember (Brian somebody, right?), and the cementing was found to not have been handled particularly well. Yet, they pumped at the designed capacity until the rig suffered the spectacular failure. We could argue whether if the fault “really” lies with BP or Halliburton, but with Halliburton’s own track record (known contaminated water supplied to soldiers, for example), anybody hiring them (and not bothering to monitor the work—skipping the bond log, in this case) should share the blame as you would if, say, you designed a carbon credit exchange with the help of Ken Lay.

There were other cost-cutting moves that were considered risky by anybody who looked at them at the time. It’s a pattern.

I hear what you’re saying about a business needing to mitigate risks, but I wasn’t talking in the abstract; the evidence is simply not in your favor. There’s a definite trend toward deliberately increasing the risk and settling cases or diluting blame when a lawsuit is possible.

As for energy use, there’s also a parallel problem with the automotive industry, isn’t there? Doubling the price for an electric car (which is four motors with wheels, a battery, and a chair, basically) is clearly not meant to push people towards conservation. And commercial solar panels aren’t much different from the models available in the ‘80s.

Lest you think I’m partisan, I think that hydrocarbon fuels are perfectly legitimate, as the energy density and stability are far better than any battery. I’ve also scrutinized many of the “core” papers regarding Artificial Global Warming (the IPCC’s website has a good start) and think they’re naive at best, fraudulent at worst. So this isn’t about oil or gas being evil. This isn’t knee-jerk tree-hugging.

I’d like to shift to something clean and renewable, mind you, just because decentralization and “free” is a far smarter way to move, given the current and upcoming state of technology and the flaws in today’s centralized structures. But I’m fine with hydrocarbons until the alternatives become economical and to fuel the engineering to get there.

My beef is in the methodology alone, the stubborn insistence on using approaches that John D. Rockefeller had available to him, mining what is clearly an organic byproduct, and mining it rather poorly on a consistent basis while refusing to acknowledge even possible impact, hiding behind the same kinds of “inconclusive by design” reports that the EPA used in the ‘70s and ‘80s to avoid dealing with Superfund sites.

Sherman
June 25, 1:19 p.m. I agree John, it is the methodology that appears stuck in some earlier age, and not environmentally relevant to current overpopulated and unsustainable earth we now inhabit. (Read recently it would take 2 earths to support humankind using the present methods!)

Certainly newer, cleaner, less intensive methods exist, most likely these have either been withheld until the next big Deepwater-type event occurs or they have been stifled by major corporate concerns who want control of them for themselves.

That’s most likely the Corporate Way these days, to hold to the status quo for as long as possible, until hands are forced either by the EPA or by some other unnatural catastrophe.

Fractalman
June 25, 3:11 p.m. John: thanks for your comments and the only emotion I’m feeling is one of frustration at the attitude you and others take to the problem of supplying energy for our world. In an earlier post you mentioned something about burning garbage or biogenic mass as a source for methane. Sure, methane comes from a lot of things. The problem is our world requires (rightly or wrongly) somewhere around 400 quadrillion (that’s with a “quad”) BTU’s every year to make it run the way it runs. I can tell from the way your posts have read that you hold companies/corporations that provide your energy at a pretty doggone

reasonable price with much disrespect to contempt. As I stated previously, I doubt you produce a single thing except opinions.

I do produce oil and gas. Not much as far as the big picture goes but I am chipping in, providing some jobs, and as a Christian, I take seriously good stewardship of the Earth. And let me tell you what the thrill from drilling into Mother Earth really is: it's exploration. It's because every time anyone drills a well we learn something concrete. It's not theory. We drill the rocks and we get to lay eyes on them. It's getting another piece to the great invisible Puzzle Beneath Our Feet. And when you find some oil and/or gas, it's awesome!! You bring it up to the surface and you sell it. Sometimes you even make a PROFIT (I know, a dirty word) and then you reinvest that profit into another test well, which could quite possibly be a dry hole, thus diminishing the profit made from the previous productive well. And like I said before, this is a tough business and it doesn't matter if you're a "mom and pop" business like mine or a BP or Halliburton, you don't purposely engage in activities that add to your costs unnecessarily. You wouldn't be in business very long. BP and Halliburton have been around for a long, long time. Do employees make mistakes or cut corners? You bet they do. Especially under fatigue. It's part of the human condition. Why, I'll bet you've even made a mistake or cut a corner, haven't you, John?

Finally, to your point about outdated methodologies, John D. Rockefeller, and poor results on a consistent basis, and with all due respect, what the hell are you talking about?! The techniques utilized today are as similar to JDR's day as the Model T is to a hybrid. Poor results?! The results are so poor that the natural gas market is glutted for probably a decade or more (barring mass conversion of the auto fleet to CNG). You probably don't know this but those same techniques are now being applied to the oil plays in the U.S. and the result is that our oil production is now at a 15-year high and headed up. Raymond James in Houston is now forecasting \$65/bbl oil for 2013.

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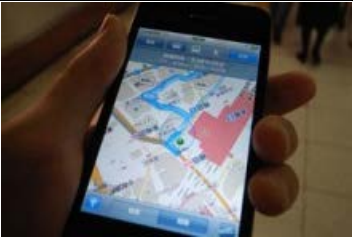
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